# Light and Lighting

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## The Queen

### God Bless Her!

ON the occasion of her Coronation, we tender to Her Majesty Queen Elizabeth II most loyal greetings and heartfelt wishes that her reign may be long, happy and peaceful. May the sun be "all ablaze with ever living glory" to light her way to historic Westminster Abbey and, amidst the pomp and circumstance of her enthronement and crowning, may she take pride, pleasure and encouragement in the knowledge that she has been already enthroned in the hearts of her peoples.

# *Notes and News*

## *Lighting in Australia*

At a recent meeting of the I.E.S. in London Mr. D. C. B. Maclurcan, a practising architect from Sydney and the immediate past-president of the National Council of the Illuminating Engineering Societies of Australia, gave an address in which he dealt with the organisation of the I.E.S. and the National Illumination Committee in that country and also drew some comparisons between lighting practice there and that in Europe.

Separate societies exist in New South Wales, Victoria, Western Australia, South Australia and Queensland, each with its own Council, the work of the five societies being co-ordinated by a National Council. As with the I.E.S. in Great Britain membership is open to anyone interested in lighting, the grades of membership being Fellows, Members, Associate Members, Sustaining Members and Affiliates. Special qualifications are required for admission to the grades of Fellow and Member.

One particular virtue which, Mr. Maclurcan said, he was also very pleased to find with the I.E.S. in this country, was the pleasant social grace of friendliness. The society embraces men from all walks of life and is not confined to those who are professionally engaged in illuminating engineering. Out of this friendliness came mutual assistance and progress.

Turning to lighting practice he said that means of artificial lighting are now a tangible medium of expression which is available to the architect in his work as a designer and no longer serve only the single purpose of making things visible. Light can be used to enhance proportions, colour, and texture, to create the appearance of interesting spacial relationships, to cause dramatic effects, harmony, comfort and peacefulness. It can be used very much as a part of architecture, but he felt that unfortunately few architects, and more unfortunately few illuminating engineers, know how. Mr. Maclurcan said it might be a good thing if a special school was established to which men from both professions could go for special training — the architects to learn something of the scientific side of artificial lighting and the lighting engineer to learn to detach himself from commercialism and salesmanship.

Industrial lighting, he said, has probably reached the pinnacle of technical perfection but other fields of lighting still leave much to be desired. There is a lot to be done in connection with the lighting of offices and schools: the greatest single creative opportunity still awaiting ex-

## *Lighting in the U.S.A.*

Dr. Ward Harrison, who is visiting Europe in his capacity as President of the International Commission on Illumination, has accepted an invitation to lecture to the I.E.S. on lighting installations in the United States. A special meeting has been arranged for 6 p.m. on Thursday, June 11, at the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.

Those who had the pleasure of hearing Dr. Harrison lecture during his last visit to this country in 1948 will look forward to hearing from him about lighting practice across the Atlantic.

ploration by the lighting engineer was probably the lighting of churches.

In Australia there is a widespread and enthusiastic acceptance of the fluorescent lamp which has had a noticeable effect on lighting practice. In his opinion it had been over-used; it had been "incongruously strung up in churches, made into whirligigs and hung in cafés, and suspended as detached four-foot lengths of glowing white light where the softness of one or two shielded incandescent lamps did the job with greater aesthetic value ten years ago."

In the case of schools advanced design is more noticeable in the few private schools rather than in the many State schools. In both cases, however, incandescent lighting as a means of general and local lighting still has an important place. This was due, he thought, to the fact that the manufacturers concerned had correctly interpreted the competition of the fluorescent lamp and had concentrated on improving reflectors and fittings. The high initial cost of fluorescent lighting had also had some effect.

Church lighting, he said, required special study; there were good and bad installations in all countries, but too often they were really bad. Those responsible for the worst crimes obviously knew little about the job; many lovely old churches were spoiled by bad lighting installations.

It was in the field of shop lighting that the greatest advances had been made in Australia. There was a willingness on the part of architects and lighting engineers working together to experiment with new ideas and though the results were not always perfect something was learned from each job. On shop window lighting he thought Europe was slightly ahead, though he had been disappointed on the whole with what he had seen in Britain. He said he had formed the opinion that in Britain there was an inclination to wait a little behind the most advanced ideas of to-day in much of the lighting, though when it was decided to do something good—such as at the Festival of Britain—the results were usually very good.

Mr. Maclurcan explained at the beginning of his address that as he had been travelling through Europe for the last few months he had been at some disadvantage in preparing his talk. However this may have been, his address, which was delivered in a most refreshing manner, was most enthusiastically received and will no doubt do much to further cement the excellent co-operation that already exists between the Australian and British societies.

## *A.P.L.E. Conference*

The annual conference of the Association of Public Lighting Engineers is to be held this year in Liverpool from Tuesday, September 15, to Friday, September 18, inclusive. The headquarters of the conference will be at the St. George's Hall, where the exhibition will be held; the meetings will be held in the Picton Hall. Full details of the papers to be presented are not yet available, but the programme will include the following: "Criteria on the quality of street lighting," by J. B. de Boer, of Eindhoven; "The design and manufacture of street lighting lanterns," by M. H. Mounsdon, of the General Electric Co., Ltd., and "Public lighting in Belgium," by Andre Boereboom, of the Ministry of Public Works of Belgium. There will also be a further paper in the series "Know your materials." At the exhibition manufacturers will be showing the latest street-lighting apparatus. There will also be a display of lamp columns, tower waggons, etc., in the St. John's Gardens, adjacent to St. George's Hall.

## *Lighting Fittings*

In this issue we are starting a feature which we hope will prove of value to all who have to use or buy lighting fittings. We have for some time given information on new fittings as they become available, but we are now presenting this information in such a way that the pages can be detached and filed for easy reference. With the help of manufacturers we hope in this way to provide a service for architects, lighting engineers and others, and to let them know of new fittings as they come on the market.

***Mercury** street lighting at Swann Street Bridge and Haymarket, Melbourne, Australia.*

# Lighting Fittings for Tropical Countries

**The following article deals with some of the technical factors which have to be considered in connection with the export of lighting fittings.**

By T. G. F. PROCTOR*

The climatic conditions of overseas territories are an important factor in the design of electric light fittings if success is to be assured when exporting to countries of tropical condition. Unfortunately designers tend to be somewhat conservative in their appreciation of these conditions, and have difficulty in believing the fact that they offer a formidable challenge to the designer of acceptable and reliable products for these markets.

At some time or other many of us have been guilty of using the term "tropical climate" without understanding its implication. We must, therefore, first define what is meant by this term, which may range from conditions of extremely wet tropical jungle to the dry, hot desert. Various natural factors such as temperature, humidity, fungi, insects and salt all play a part to some extent interdependent upon one another. Artificial factors, such as the type of building in which the fittings are to be installed have an additional influence. The common use of sheet iron roofing in some territories is a factor which cannot be overlooked and will itself tend to produce tropical conditions.

It is impracticable to prepare a specification to cover each degree of influence that these various factors bear one with the other, but it is general to specify tropical climate as having an ambient temperature not exceeding 104 deg. F. (40 deg. C.) with a relative humidity of 90 per cent.

Table 1 gives examples of ambient temperatures and relative humidities which are experienced in some of these countries where a large potential for the export of both decorative and industrial fittings exists.

Not only do these conditions affect the choice of suitable materials with which to manufacture fittings, but they have a direct influence upon the mode of local architecture with which fittings design must be a working partner.

### The Influence of Local Natural Conditions

The most important problem to be overcome by the designer is the provision of sufficient ventilation for the lamp whilst at the same time making the fitting insect proof. The most attractive fitting designs can be rendered ineffective within a few hours of switching on due to the ingress of insects. These, attracted by the light, enter into the glass, and upon dying join their many other comrades to be silhouetted as a dark mass inside the fitting until removed next morning by the handful. Generally these problems are overcome by employing totally enclosed screw-neck globes incorporating rubber gaskets. Where more decorative fittings are considered, however, the problem must be overcome by means of tight-fitting dust covers, or alternatively the judicious incorporation of a louvre within the fitting which will enable the insects to fall out of the fitting upon dying and not detract from its general appearance.

Similarly, special consideration must be given to lamp shades. Imitation vellum which is so commonly used in more temperate climates only makes an appetising meal for insects that inhabit certain tropical countries. Plastic shades employing mediums similar to Celestoid, however, whilst being impervious to the attack of

* General Electric Co., Ltd., London.

**Table 1**

| Country | Ambient Degrees C. | Temperature Degrees F. | Relative Humidity per cent. | Atmosphere |
|---|---|---|---|---|
| India | 32 | 90 | 90 | Saliferous |
| Bahrein | 42 | 108 | 92 | Saliferous Alkaline |
| Suez | 45 | 115 | 50 | Sand |
| N. Venezuela | 35 | 95 | 67 | Saliferous Sand |
| Borneo | 25.8 | 73 | 89 | Saliferous |
| Malaya | 32 | 90 | 91 | Saliferous |

insects, tend to grow a mould in a climate where a high humidity is experienced.

The use of soft woods for fittings manufacture is not advisable in tropical countries of high humidity. A fitting manufactured of such material will in a few months tend to warp; it will also be subject to white ant attack.

**Influence of Climatic Conditions**

In considering tropical conditions, humidity and temperature become inseparable factors. Whilst temperature in itself is not a governing factor it accelerates the deterioration from other factors, particularly humidity.

*Humidity*

Humidity is the amount of moisture that the atmosphere contains and is by far the worst enemy in the tropics. Without this factor most materials would withstand the climatic conditions without any special precautions. The humidity varies in different localities and is never constant even in any one place. When the atmosphere is fully saturated with minute water particles at a particular temperature the relative humidity would be expressed as 100 per cent. This in practice is seldom reached

**Table 2**

| | Air Temp. Deg. F. | Relative Humidity per cent. | Water per. cu. ft. of air. grains |
|---|---|---|---|
| U. Kingdom | 60 | 90 | 5.1 |
| India | 90 | 90 | 13.2 |

*Fig.* 1. *Crystal chandeliers in the Town Hall of Lourenço Marques.*

*Fig. 2. Cold cathode cornice lighting in the air-conditioned Capitol Cabaret, Singapore.*

except in fogs or mists. Sea air naturally has a high relative humidity, possibly over 90 per cent., but land air may be as low as 50 per cent., whilst over deserts even as low as 20 per cent. The relative humidity experienced in the United Kingdom ranges from 30 per cent. to 72 per cent., but in those countries where trade winds and monsoons are experienced the relative humidity, which may be above 90 per cent., becomes a factor which when viewed in relation to temperature is of major importance.

Whilst the relative humidity may be the same in different localities, differences of temperature increase or decrease the moisture carrying capacity of the air as shown in Table 2. It will be seen that for the same degree of relative humidity in typical temperature conditions there is 2.6 times as much moisture present in the tropical atmosphere. These particles of water, in a highly agitated state and travelling at high velocity, are able to penetrate materials and spaces normally considered moisture-proof or air-tight.

*Temperature*

It has been stated that temperature in itself is not a major factor, but it should be borne in mind when considering melting points of compound fillings for chokes and other ancilliary components required for the operation of fluorescent lamps. It must also be mentioned that fittings exposed to direct sunshine may reach a temperature of 167 deg. F., which is quite formidable. In addition, the sunlight, apart from temperature consideration, causes the ozonisation of rubber gaskets.

*Salt*

Due to the high tropical temperatures, evaporation rate is correspondingly high. The monsoons and trade winds prevailing collect from the sea a large salt-water content. In the Persian Gulf this saliferous content is extremely high and is most corrosive to all metals unless adequate precautions are taken to protect them.

**Architectural Influence on Design**

The design of decorative fittings for the tropical conditions of the Middle and Far East must conform to the living standards experienced in these territories. These standards call for rooms which are generally high and open for coolness, having terazzo tiled flooring and white distempered walls. In such a room decorative fittings with which we are more familiar in this country would look out of place, and here fittings with the minimum of period influence but contemporary in design are more suitable. Owing to the higher ceiling the overall drop of pendant fittings will be greater than the general 3 ft. 6 in. considered suitable in this country, and designers must be prepared for proportioned fittings having an overall

down drop of between 4 ft. 6 in. and 5 ft. As fans are in common use, the mounting height of fittings is dependent upon the level of the fan blades if annoying flicker is to be eliminated, and for this reason ceiling mounted fittings are not popular.

In more temperate climates the influence of local architecture has the opposite effect. In New Zealand, for example, dwelling houses are mainly of the bungalow type, having ceilings which seldom exceed 8 ft. in height. Such small head room precludes the use of centre pendant fittings unless these can be shortened without detracting from their aesthetic proportions. This, therefore, creates a demand for ceiling mounted fittings supplemented by wall brackets and portable floor and table standards. In a minor way similar conditions are experienced in Australia.

In all territories, however, special consideration must be given to the design of fittings suitable for the larger public and municipal buildings, banks, cinemas, theatres, etc., and each must be treated on its own merit.

### Local Wiring Problems

In many tropical countries concealed wiring installations offer considerable problems. In hot humid countries conduit wiring can prove very costly and offers problems of drainage if the conduit is not to fill up with condensate to the detriment of the wiring. An added problem is the permeation through the plaster to the conduit surface of atmospheric moisture often accompanied by sodium chloride from the plaster. This not only causes rusting and eventual discoloration of the plaster, but also fungoid-like growth which may produce sufficient pressure to break the surrounding plaster.

Because of such problems, concealed wiring installations may not be allowed in many territories. These restrictions necessitate surface wiring, usually in the form of T.R.S. cable carried on teakwood batten or V.R. cable on porcelain cleats. Both systems, though common, are somewhat unsightly. The number of lighting points is therefore kept to a minimum and higher wattage fittings used. (The use of higher wattage lamps means also that special attention must be given to the avoidance of glare.)

In overseas territories the bayonet cap lamp is by no means general, and fittings designed to meet these markets must be equally suitable for both bayonet and Edison screw lamps. This interchange can generally be effected without trouble, although certain modifications must be made when fitting table or standard lamps with Edison screw lampholders. Provision must be made for a special shade having a frame with a 1¼ in. diameter hole and a gimbal which is 1 in. shorter than normal to overcome the higher lamp position when using an Edison screw holder.

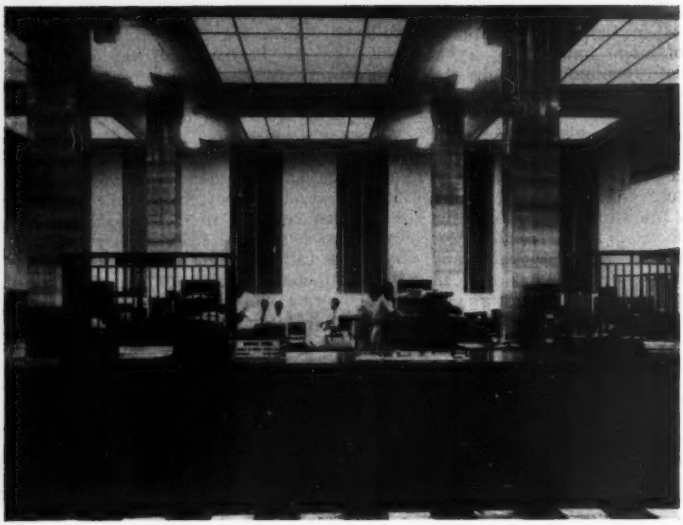


*Fig. 3. Hot and cold cathode lighting in the Hong Kong, Shanghai Banking Corporation, Singapore.*

*Fig. 4. The harmony of fittings design and contemporary architecture.*

### Corrosion and Metal Protection

The effect of saliferous humidity and temperature lead to the formation of rust in iron and steel work with a subsequent weakening of the metallic structure. The rust forms slowly at first but it is of such a porous nature that it aids in bringing the moist air and metal into closer contact, and the corrosion once started rapidly proceeds. This is further accelerated by the presence in the atmosphere of carbon dioxide.

Steel, or pig iron from which all oxygen has been expelled and the carbon content reduced to 0.25 per cent. is commonly used in the manufacture of industrial fittings. The addition of 0.5 per cent. copper—described by American manufacturers as "copper bearing steel"—is beneficial in increasing its corrosion resistance. Nickel steel containing 25 to 40 per cent. nickel is highly resistant to corrosion, but these materials are somewhat costly and means must be devised to protect the cheaper materials commonly used in fittings manufacture.

Copper under humid conditions becomes covered with a green basic carbonate, especially if the atmosphere has a high carbon dioxide content. Alloys of copper, such as brass, are fairly resistant to corrosion, and alloys of zinc have also been found satisfactory.

### Enamel Finishes

In the industrial field the designer is more concerned with climatic conditions rather than with the architectural influence. In this field the medium most commonly employed for the manufacture of fittings is sheet steel, and special techniques must be used to protect the metal from atmospheric corrosion. Clean steel surfaces, especially those which have been treated by abrasive blasting, are very subject to rusting unless covered by a film of vitreous enamel or a well-keyed coating of stove enamel free from craters.

Generally the sheet metal must first be processed to remove all grease, oil and mill scale. This is followed by one of the many surface conversion treatments known to the trade such as "Bonderising" or "Parkerising," or "Granodizing," in which phosphoric salt solutions produce a film layer on the metal which so long as the film remains

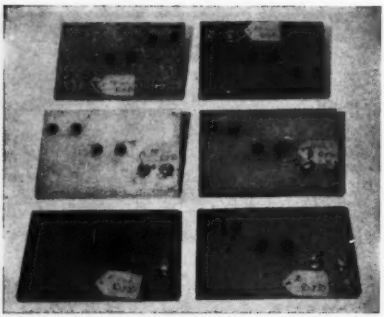


*Fig. 5. Exposure test on aluminium cast slabs.*

of stoving as recommended by the paint manufacturers. Such a stove-enamelled fitting should give satisfactory results when tested in a humidity cabinet for 500 hours under conditions of 45 deg. C. and 95 per cent. humidity. The importance of obtaining a crater-free surface in the finished stove enamel cannot be too strongly emphasised, since under humid conditions any craters in the paint film surface will be the seat of commencement of metal breakdown. This breakdown will spread from the crater underneath the paint film throughout the fitting until blistering and subsequent flaking of the stove enamel results.

An alternative to a stove enamel is vitreous enamel. In this process, however, special high grade steel must be used to withstand the higher oven temperatures used,

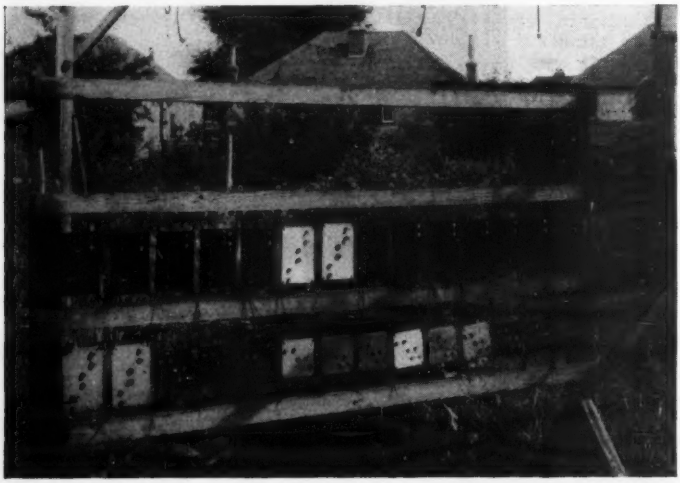


*Fig. 6. A typical test station for the weathering of aluminium cast slabs.*

intact and painted prevents rusting. An added advantage in the use of these methods of metal pre-treatment is that the phosphoric salt forms a crystalline structure upon the metal surface which greatly improves the adhesion or key of the additional paint films.

Following this treatment of the metal an inhibitive primer such as red oxide or zinc chromate is applied. This should be followed by a liquid or paste filler to give an even surface to the metal in order that the final paint film will be without craters. It is general practice to follow the priming and filler coats with an undercoat followed by two coats of stove enamel. It is essential throughout this process to pay particular attention to the temperature and duration

*Fig. 7. Anodised aluminium alloy street lighting reflector after three months' exposure.*

and the design of the fitting must be such that sharp corners are avoided so that under oven conditions the vitreous flows evenly over the entire surface of the metal. It is essential that at the time of installation the surface of the vitreous enamel must be free of chipping, otherwise similar deterioration as experienced with stove enamel will result, although this will of course develop after a longer period of time. This attention to metal finish is the ideal to be aimed at but all too often in the highly competitive export market cost and the price the customer will pay are over-riding factors.

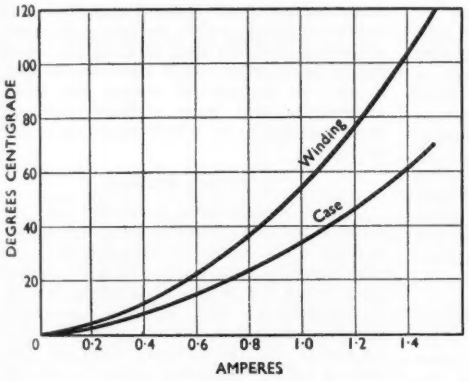



*Fig. 8. Current-temperature rise characteristic for 240/250-volt brick choke in free air. Somewhat smaller temperature rises occur with chokes of the same type for lower supply voltages.*

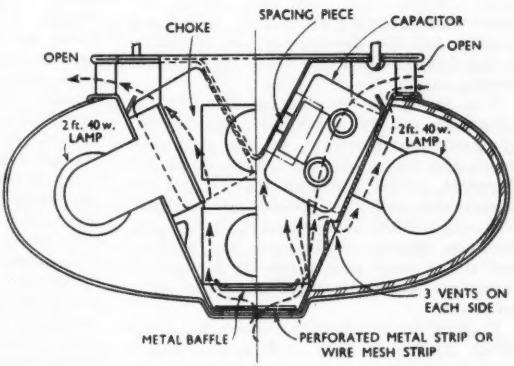



*Fig. 9. An example of fittings design giving good ventilation and thermal conductivity.*

### Fluorescent Lamp Control Gear

The use of fluorescent lighting is becoming increasingly popular overseas and whilst those factors governing the design and finish of a fitting for these markets are similar to the considerations given to fittings employing other illuminants, special attention must be given to the design of fluorescent lamp control gear.

The design of a choke must be such that it is able to dissipate heat corresponding to its energy loss without an excessive rise in temperature. If it were not for the resultant bulk and increased manufacturing cost there would be little difficulty in attaining this ability. In a competitive market, however, an economic mean must be achieved between temperature rise, bulk and cost, which without sacrificing reliability, allows for a temperature rise within the limit set by the insulation used and compatible with the worst service conditions catered for.

In high ambient temperatures, the operating temperature of the choke is increased either by external conditions or by the enclosed nature of the fitting. At ambient temperatures above 78 deg. F. the mercury vapour pressure within the lamp varies with a consequent lamp current rise and resultant

voltage fall. This alteration in lamp characteristic requires the choke to carry a heavier current, which further increases its operating temperature.

Under these conditions heat dissipation from the choke is dependent upon good thermal conduction, which must be achieved in the initial design. This dissipation can be further assisted by assuring that the choke is in good thermal contact to the metal of the fitting which is in contact with the air. Greater thermal conductivity can be secured by using metal shims between the choke and metalwork of the fitting.

Since capacitor life varies inversely with temperature, it follows that it is desirable to locate this component in as cool a position as possible, keeping it away from all metalwork which might transfer heat to it by conduction. In high ambient temperatures it is essential to provide a good seal where the connecting leads emerge against leakage of the filling. With a good seal capacitors should be capable of withstanding continuously a temperature of up to 158 deg. F., which gives a liberal safety factor.

### Packing

The fittings export market is a highly competitive one, and especially so when marketing in territories enjoying lower manufacturing costs and cheaper labour. To some degree this can be offset by better manufacturing techniques, design and quality, but the disadvantage of manufacturing 5,000 miles away from the ultimate market cannot be overcome.

It is during the design stage that this disadvantage can be realistically approached by giving consideration to the ease with which the fitting can be broken down for shipment, whilst ensuring that it can be reassembled without difficulty upon arrival. Not only will this reduce freight charges, but minimise damage in shipment and landing, and at the same time bring the blessing of customers whose storage facilities are at a premium.

Packing for shipment is a technique about which much has been written, and which made great strides during the last war. The British Standards Institution issued a supplement to B.S.1133 in 1943, and a publication was issued in 1949 by the Ministry of Supply under the title "Tropic Proofing."

It must, however, be appreciated that in tropical waters the humidity in a ship's hold may reach 100 per cent., and the quantity of water condensing against the inside of the hull may be considerable. A large amount of water may be accumulated inside packing cases on account of the moist air which they breathe in. These conditions are extremely difficult to deal with, but may be helped by providing cases with good ventilation. Packing material must be chosen with care; wood wool, so often used, loses all elasticity when it becomes humid, apart from forming an excellent medium for mould. All corrugated cardboard should be chemically inert, otherwise when humid it will stain paint finishes. Material should always be packed in specially treated wax paper, and in certain cases it may be a good policy to include within the case a moisture-absorbing chemical such as silica-gel, which should be effective for at least two months. It will be realised, of course, that price competition will have a direct influence upon the degree to which these ideals can be carried.

### A Typical Problem

Certain installations overseas must be catered for by manufacturing techniques beyond those normally required to withstand tropical conditions. Such a problem arose when the design of a fitting suitable to withstand the arduous conditions experienced in the Indian mills was contemplated. In the weaving sheds of these mills a forced humidifier system is used to attain a constant humidity of approximately 87 per cent. The humidifiers, which are mounted upon the roof trusses, blow a constant stream of water mist, more than often directly in line with the lighting fittings. Under such conditions even the best stove-enamelled finish would be quite useless, and although vitreous enamel has proved more successful its expected life in these conditions is considerably reduced. An analysis of the water taken from the humidifier system left little doubt that the deterioration of the fittings was not due to the impurities within the water of the humidifier system, but that the constant conditions of large-scale condensation surrounding the fittings were directly responsible. Deterioration of the fittings was further aggravated by cotton fly, which, in a wet state, spread upon the fitting covering it in a cocoon-like coat; due to the continued decomposition of this cottonfly organic acids were formed which contributed to the breakdown of the fittings.

The answer to such a problem (assuming that it is considered desirable that the base construction of the fitting should remain in sheet metal) is to paint the complete

(*Continued on p.* 223)

# Background of Research

**The British lighting industry has a reputation for research of the highest order. Continuous research is carried out on lamps, lighting fittings and equipment which results in products of a very high standard.**

By W. R. STEVENS,*
B.Sc., M.I.E.E., F.I.E.S.

The lighting industry, in common with many others, has a chain of research stations studying problems ranging from those fundamental to seeing to the design and testing of lighting equipment. The fundamental work which has no immediate commercial objective, such as measurement of the properties of the eye, and studies of glare and brightness distributions, is an essential part of the background of research both because it makes a contribution to knowledge and because it gives a sense of perspective to the everyday problems.

However, most of us, although interested in the fundamental work, are more concerned with the quality of the goods which we purchase; and this is natural enough since a lighting installation, however it is planned, consists of hardware, such as lamps and equipment, which must give a satisfactory performance not only when installed but through a life of many years. Therefore this article is concerned only with the important, if more mundane, aspects of the work of a laboratory on design and testing.

To obtain a broad picture of the part played by the laboratory in producing a new fitting it is interesting to follow quickly the progress of a new design.

The first step, and often the most important and difficult one, is to decide what is required of the fitting. In consultation with the sales engineers, who from their frequent contact with customers have a good knowledge of the lighting problem, the light distribution required from the fitting must be determined. The sort of questions to be answered are: What surfaces have to be lighted—are they vertical, horizontal, or at another angle? What will be a likely mounting height? What is the reasonable spacing for the fittings? The answer will be a compromise in which costs (both initial and running) will play an important part. The design of a lighting unit is almost invariably such a compromise. The discussion on desirable light distribution will be intertwined with thoughts on the materials to be used, and the decisions taken will again depend on costs as well as the nature of the conditions in which the fitting is to be used. For example, high-bay units are installed in both steel works and in aircraft hangars; the one has an atmosphere which will corrode almost anything, the other a very clean atmosphere. Is it possible to design economically a unit which will do both jobs —even assuming the same light distribution is satisfactory for both—or will it be necessary to have two units?

Supposing some fair agreement on these matters has been reached the designer may go ahead. The first steps in the design will be on paper; possibly a few "doodles" which display the designer's hopefulness rather than any rigid adherence to the fundamental laws of reflection and refraction. It is astonishing how many designs will work admirably in a rough sketch, but fail lamentably when they are set out accurately and translated into a real fitting. As soon as possible, therefore, after the drawing-board stage an experimental sample will be made. This sample may have

*. . . a few doodles . . .*

*Research Laboratories of The General Electric Company, Limited, Wembley, England.

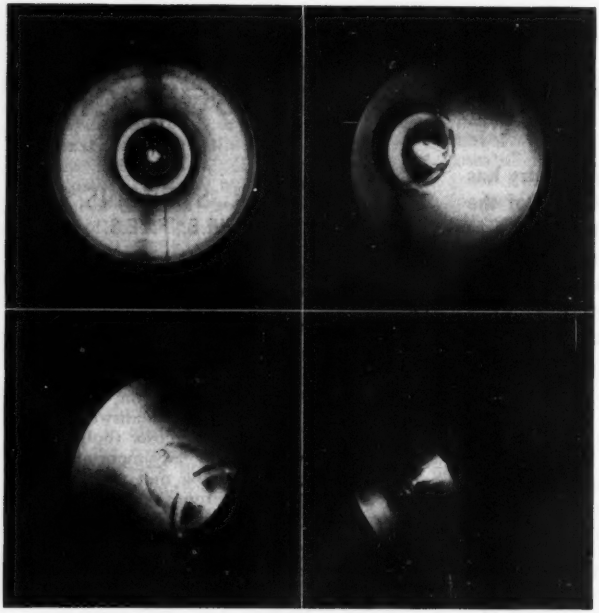


*Fig.* 1. *"Flash" photographs showing (i) reflector, vertically below fitting, (ii) reflector* 20 *deg. from vertical, (iii) reflector* 40 *deg. from vertical, and (iv)* 60 *deg. from vertical.*

to survive some rude comments from the commercial engineers, who will probably find it too big, too fragile, impossible to pack, and quite unlikely to do the job as they have defined it.

Nevertheless, the designer will carry on. The light distribution is measured. If, as frequently happens, it is not exactly right, a good deal may be learned by studying the flash at various angles of view (Fig. 1). An important question to settle at this stage is whether the discrepancy is due to an error in the manufacture of the sample, or whether some mistake has been made in the design calculations. It is often difficult to answer this question, particularly if the design is a critical one in which very small changes in the manufactured product can make large changes in the light distribution. If the design is too critical it may have to be scrapped as being impracticable for economic production, and the designer must start all over again.

At this stage measurements may be made of the temperatures of various component parts of the fitting and in particular of the lamp cap and the leads. If the results are not hopeful it may be necessary to study the air flow in and around the fitting. The flow path of the hot air will also have a considerable effect upon the deposition of dirt and, therefore, upon the frequency with which the fitting will need to be cleaned in service.

All being well, the next step will be to test a few prototype fittings. In these, of course, faults found in early samples will be corrected, and comparison of the performances of several fittings will confirm that the inevitable tolerances in manufacture are acceptable. Not until such measurements and a variety of others have been made is it safe for the works to start production.

The designer has now completed his job: but he may not have heard the last of this fitting, for routine checks on the product may show that its performance has drifted too far from the objective because of some change in procedure at the works, or because an error has crept into manufacture (and this will happen from time to time in the best-regulated factory). If none of these things occurs and the fitting proves successful on the market, there is a strong possibility that a demand will arise for a slightly modified form of the fitting to serve some purpose a little different from that first contemplated. These "small modifications" often sound ridiculously simple to those who

make the request, but equally often they prove very difficult. One of the most frequent requests is to make the equipment accommodate a slightly bigger lamp. Mechanically this may only involve lengthening the neck of the reflector or altering the canopy to bring the lamp light centre to the correct position; but it is a fortunate circumstance if this does not at the same time overheat the lamp cap and the cables.

So far in this account we have been content to say that this, that, or another step was taken in the design and test procedure: a suitable material is chosen; temperature tests are made: but each of these steps rests on the experience built up from many years in the laboratory, and it is interesting to examine in more detail what is involved.

### A Suitable Material is Chosen

Many properties of materials can be settled by quick tests; for example, tensile strength and density. But one of the most important properties, namely corrosion, can be evaluated only after long and closely controlled testing. There are some forced tests available, but on the whole there is no real substitute for putting samples out in the open air or whatever other type of atmosphere they may have to withstand in practical fittings, and observing their behaviour over many years.

Now it frequently occurs that a material will suddenly recommend itself for a particular job, although it has been used very little before. This may arise because it has particularly convenient physical properties for some special type of installation, or because its price has fallen relative to the more usual materials. In the former class will be such a material as polymethylmethacrylate ("Perspex"), which was introduced on the lighting market soon after the war and which had obvious advantages over glass and even metal for some types of work. In the second class is aluminium which, although it was used to a small extent before the war, did not become really popular until the high war-time production brought down its price so that it was able to compete with iron and steel. With both of these materials a great deal of work was needed to determine resistance to corrosion. It happens that the answer was fairly straightforward for "Perspex," since it is inherently very stable, but much less simple for aluminium. One of the tasks, therefore, of a research laboratory is to have new materials constantly under review and observation even though they have not reached the stage at which they could be used economically in the general run of lighting fittings. Such tests will not be confined to basic materials but will include also paints and other protective surface finishes.

The usual procedure is to have test stations in different parts of the country (Fig. 2) and

*Fig. 2. Corrosion test racks.*

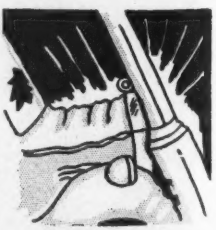
*Fig. 3. Polar distribution photometer.*

possibly even abroad to cover a variety of atmospheres such as urban, suburban, and marine. Most tests are made on small samples of the materials, but complete fittings are also exposed since they afford an opportunity for studying components such as hinges and catches which go with the main body of the lantern.

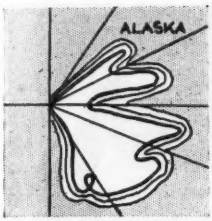
It should be possible to get much useful information by studying installations. In practice this is less easy than it seems because of the difficulty of keeping the experiments under careful control. Works engineers and public lighting authorities cannot be expected to modify their maintenance arrangements to meet the particular needs of an experiment; nor is it generally easy to obtain exact records of, for example, the number of hours during which the lantern was lighted. Again there is always a tendency, if some unexpected deterioration occurs, to blame it on to a peculiarity of the installation and to regard it as not typical. On the whole, therefore, although useful information can and should be derived from installations it is essential to conduct experiments under the direct control of the laboratory.

### The Light Distribution is Measured

The advent of the photo-electric cell has made photometry appear simple; this appearance is deceptive. The light meter to be produced from the pocket at a moment's notice is as essential a part of the lighting engineer's equipment as is the cathode ray oscilloscope in other fields of technology. But not one light meter in ten seems to have been calibrated within living memory. In the laboratory, all photometric apparatus must be calibrated frequently and regu-



*—difficulty of keeping the experiments under control . . .*




*—a simple polar curve . . .*

larly; a common practice is to check portable instruments (both visual and photoelectric) once a week and to calibrate the distribution photometer (Fig. 3) and the integrating sphere photometer before and after each period of use. Calibrated standard lamps are also required for use in the fittings to be tested, and because there is a great variety of different types of lamps used there must be a great many calibrated lamps. The number of calibrated lamps, therefore (that is, lamps whose light output or directional intensity is known to within 1 or 2 per cent.), may well be between 500 and 1,000 in a laboratory doing a fair amount of photometry. The problem of regular checking for these lamps is in itself considerable, for many of them must be remeasured at least every 100 burning hours and very few will be allowed 500 hours of use before they are remeasured. Thus, when an observer sits at a photometer taking, say, a simple polar curve of a lighting unit, he is making use of the work of a considerable team of people who are keeping his apparatus in working order.

Much attention is paid to reducing the time and labour involved in measuring light distributions; for the lighting engineer (as opposed to the photometrician) is interested in the result rather than the method by which it is achieved. Thus, we find many ingenious modifications of apparatus used in different laboratories to speed and simplify work. In the polar distribution photometer, for example, it is usual to arrange that the light distribution be plotted directly on a sheet of polar co-ordinate paper by following the position of a galvanometer spot. On such an apparatus the light distribution can be measured in perhaps a third of the time which used to be necessary with two observers straining furiously to take visual readings with a Lummer-Brodhun photometer head. But a careful check must always be kept upon the accuracy of the instrument, for the more facile the device the more the errors into

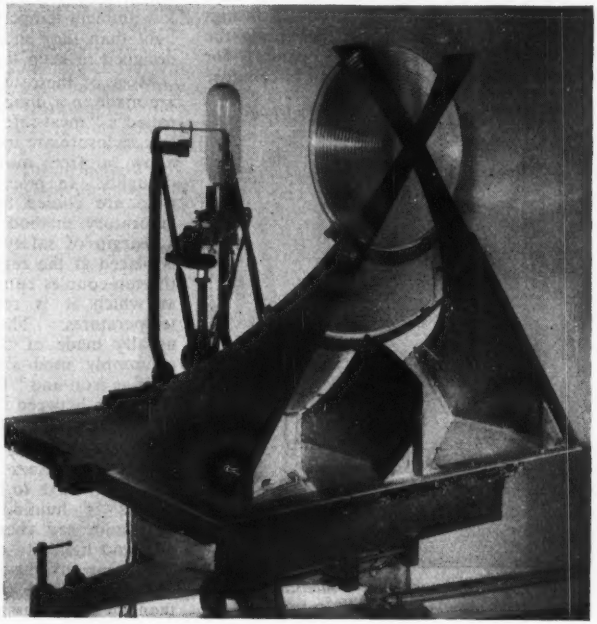


*Fig. 4. "Mock-up" unit on rotating photometer turntable.*

which it can lead before the mistake is discovered.

This speed-up of photometric procedure has proved invaluable to the designer, for it is now relatively simple to erect an embryo fitting with the aid of string and sealing wax and check its performance as a series of small modifications is made. Often this is a better procedure than attempting to design a fitting outright on paper, and experience enables the skilled experimenter to try a great variety of optical arrangements in mock-up form fairly quickly (Fig. 4).

### Temperature Tests are Made

The operating temperature of a lighting fitting is generally a controlling factor in its design, for although the metal work is seldom overheated in ordinary lighting equipment, many other commonly used materials have a strict upper limit of safe operating temperature. As examples, silvered glass (unless of a special kind) should not operate above 180 deg. C. Rubber-covered flexible cables should not operate at more than 50 deg. C. "Perspex" tends to soften quickly above 70-80 deg. C.: the temperature at which lampholders can be used safely is limited by the springs used in them, and the temperature of lamp caps by the capping cement. For other fittings there may be a specification governing the temperature at which they operate; for example, flameproof fittings used in cellulose

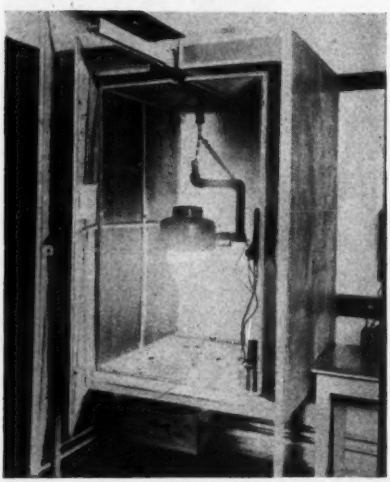


*Fig. 5. Temperature measurement enclosure.*

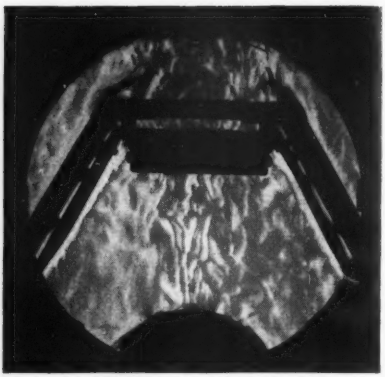


*Fig. 6. "Schlieren" photograph showing air flow through a louvre system.*

spraying booths and coal mines must not exceed a temperature rise of 50 deg. C. on any part of their surface. Less frequently the reverse problem is encountered and the fitting must not be allowed to get too cold; for example, fluorescent lamps have a relatively small range of temperature over which they operate at nearly maximum efficiency, and if they are burned in the street at very low ambient temperatures they may give less light than they should if the lantern is not designed to keep them sufficiently warm.

Most of these temperature measurements are made in a double-walled enclosure often called a "meat-safe" (Fig. 5). The walls of the enclosure are made of perforated zinc to allow a free movement of air without draughts. In practice, of course, most fittings are cooled by draughts so that this laboratory method of measurement allows a margin of safety. The fitting under test is placed at the centre of the enclosure and thermo-couples connected to it at the points at which it is required to measure the temperatures. These thermo-couples are usually made of thin wire (36 s.w.g. is a commonly used size) of dissimilar metals such as iron and "Eureka"; and the voltage difference between the hot and cold junctions of the thermo-couples is measured.

Sometimes these tests have to be made at very high ambient temperatures and sometimes they have to be made in extreme conditions of humidity: for such work an air-conditioned chamber in which temperature and humidity can be closely controlled is a great advantage. Sometimes, too, it is necessary to take more account of draughts than merely to assume that they will allow

a margin of safety. A lantern for exterior lighting, for example, will be cooled by wind for a large proportion of its life, and this may ensure a satisfactory performance from a material which appears too hot when measured in still air.

In order to explain the temperature results it may be necessary to study the air flow in and around the lighting fitting. One method is to use tiny smoke generators and to watch the path taken by the smoke trail. Another, and more sensitive, is the Schlieren method, which shows up air flow by showing the changes in refractive index of the air caused by changes in temperature (Fig. 6).

Our knowledge of materials should be such that if we know the temperatures at which the various parts of a fitting are operating we should be able to predict whether it will perform satisfactorily in given conditions. Nevertheless it is common to subject exterior lighting fittings to an artificial rain splash, both to check that water cannot enter and to ensure that the glassware will not break in a rainstorm.

### A Variety of Others

One of the attractions of a research laboratory is the variety of jobs to be tackled, and test methods which have to be devised and applied. For example, problems associated with vibration are frequently encountered; but although these problems may have to be studied on the site it is generally convenient if they can be reproduced in the laboratory and studied there. Many vibration machines have been devised from time to time and the one illustrated (Fig. 7) has seen most of its service in testing street lighting lanterns, although the effect of vibration on industrial equipment and lamps is also studied with its aid. It can be adapted to give frequencies up to several hundred per minute with an amplitude of several inches; and in general, a lantern which survives for 500 hours on this apparatus will have a life of many years in practice.

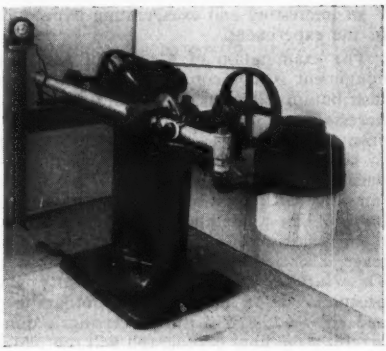


*Fig. 7. Vibration machine.*

Lighting fittings often have to be tested with internal pressures of several pounds to the square inch. This is often conveniently done by placing the fitting in a water bath, pumping in air with a bicycle pump and observing whether air bubbles leak out of the fitting. The apparatus used is simple; complexity of equipment is not always a useful criterion of its effectiveness. The study of underwater fittings such as underwater floodlights also demands a large tank and a great deal of water; and this usually leads to a study of the growth of algae in the tank

*Fig. 8. Section of prismatic glassware.*

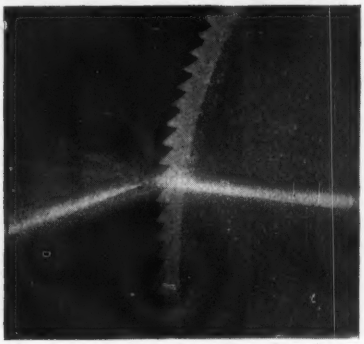


*Fig. 9. Ray path through prism showing loss due to malformation.*

—an interesting and exasperating byproduct of the experiment.

The examination of a piece of prismatic equipment is not completed when its light distribution has been measured, for it is also necessary to study the prism contours to ensure that they have been pressed accurately to the design. Of the various techniques which are available for doing this two simple ones are particularly worth mentioning. For both of these methods a section is taken from the prismatic glassware, and ground to leave a smooth but lightly frosted surface. This surface, which displays clearly the prismatic shapes, may now be photographed and enlarged; and if the processing is done carefully the final photograph will reproduce closely the prism shapes (Fig. 8). Measurements of length and angle can then be made to check the prism formation. Alternatively, the ground surface may be stuck to a piece of ground glass and a ray of light passed through the prisms, the ray being arranged so that it skims across the ground glass. Its deviation can then be measured for each prism in turn. If desired, of course, the ray traces can be photographed (Fig. 9).

Photography is an important tool in the illumination laboratory. In street lighting studies it may be used to transfer the problem of brightness measurements in the street to one of measuring densities in the laboratory. This is done by photographing the street under carefully controlled conditions and then, after suitable processing, measuring the density of various parts of the plate and recording the results on a print. The apparatus can be calibrated so that the final record is given in terms of luminance. This technique has been very valuable in studying the formation of bright patches on the road and enabling us to understand how to plan a street lighting installation to give the best results (Fig. 10).

### Routine Checks on the Product

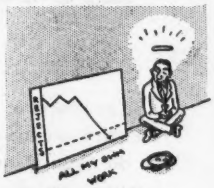
Most of the tests so far described can only be made satisfactorily in a laboratory, because they require expensive apparatus and skilled operators. Many other tests, however, are set up in the factory, generally to control a particular product. Such tests need to be simple and nearly foolproof and are best based on some salient feature of the article under examination; for example,

*Fig.* 10. *Contours of equal luminance from a single street lighting lantern. Obtained by photographic photometry.*

the angle of maximum intensity in a lighting fitting, or the transmission of a piece of glass.

The great advantage of testing in the works is the speed with which the results can be obtained. For a test will not, of itself, correct a faulty article. Its prime purpose is to detect an error quickly so that the manufacturer can put it right quickly. The careless pedestrian's life is not saved simply because the driver sees him step off the kerb, but only because as a result of what he sees the driver applies the brakes in time. The sooner the driver sees the danger the sooner can he apply the corrective. Similarly, the sooner the manufacturer can see his product is falling below standard the sooner can he put it right.

The effect can be considerable. Recently we were concerned with a piece of prismatic glassware which it was particularly difficult to make. The initial reject rate was some 35 per cent. of the production. Installing suitable test gear was largely responsible for reducing the reject rate to below 5 per cent.




—*Endpiece . . .*

## Fittings for Tropical Countries

(*Continued from p.* 214)

fitting with a chlorinated rubber paint. These chlorinated rubber paints are available in a wide range of colours, including white, with which the reflector should be painted. An alternative would be to design an industrial fitting incorporating rigid P.V.C., although particular attention must be paid to the ambient temperatures in which this fitting is to be installed.

### Conclusion

Without any doubt the British electrical industry can produce first-class lighting fittings, but designers, manufacturers and packers must appreciate the problems of the overseas markets. With a full understanding of these requirements the design of fittings should be approached with a view to their marketable value overseas. Much greater attention should be paid to standardisation wherever this is practical, and to the possibilities of tropicalised fittings, paints and correct packing methods.

## Obituaries

### MR. H. A. LINGARD

Mr. H. A. Lingard, for 17 years a director of the British Thomson-Houston Company, Ltd., died at his home in Ewell, Surrey, aged 70, on Saturday, April 18. Mr. Lingard played an important part in building up the lighting industry in this country.

He joined the B.T.H. company in 1904. Between 1908 and 1913 he worked in Canada with the Canadian General Electric Company. On returning to England he joined the B.T.H. company's export department, and in 1928 became general manager of the Lamps and Lighting Department. Three years later he was made a director of the company.

In the course of his long association with the electrical industry Mr. Lingard achieved a reputation for his judgment and foresight, which best showed themselves during the difficult inter-war years, and he played a very important part in bringing about the stability in which the lamp and lighting manufacturing industries of this country find themselves to-day.

Mr. Lingard was also director of the Hotpoint Electrical Appliance Company, a member of the Council of the Electric Lamp Manufacturers' Association, and at one time was a member of the Council of the Illuminating Engineering Society.

Following his retirement in April, 1948, he continued to follow keenly the progress of those interests in the electrical industry with which he had been associated during his business life.

### MR. R. R. VENNING

We announce with deep regret the unexpected death, on May 6, of Mr. R. R. Venning. Mr. Venning, who was 36, had been ill for some time recently and returned to duty apparently in far better health than he had enjoyed for two or three years. He leaves a widow and son and daughter.

After six years' war service, for which he was awarded the M.B.E., Mr. Venning, a former student of Faraday House, joined Philips Electrical, Ltd., in 1946, as manager of the Fittings Section of the Lighting Department, and on the formation of the Light Group in 1950 he became manager of the Lighting Fittings Department. He was a member of several committees of the Electric Light Fittings Association.

His friendly, considerate and courageous personality will be sadly missed by his many friends in the lighting industry.

# Electric Lamp Progress

By W. J. JONES, M.Sc., M.I.E.E.*

**The products of the British lamp industry are acknowledged to be of the highest quality. The following article comments on some of the advances made in recent years and their value to the user.**

The most valuable presents are said to come in small parcels. Little improvements in lamps—particularly in the popular sizes of filament lamps bought in millions—mean that the public as a whole benefit considerably, though they may not be aware of the fact unless anything has outwardly changed. Except that we are now putting 60-watt filaments in 40-watt size bulbs, the outward appearance of most filament lamps has not changed for some years.

### Quality Control

Nevertheless, constant research work, and in particular rigorous statistical quality control which is in force in all first-class factories, and is in fact the only possible means of ensuring that the lamps reaching the open market were good yesterday, are good to-day, and will be even better to-morrow—these have had their effect in enabling still greater uniformity to be obtained. Incidentally, the British lamp industry pioneered the statistical method of quality control which has now been in operation for over 20 years, and the results of this enterprise, initiated by Dr. B. P. Dudding, have been applied to improve the efficiency of many other industries.

At the present time 95 per cent. of general lighting service filament lamps are within $\pm$ 6 per cent. of their target efficiency, and the virtual elimination of the odd few lamps having exceptionally high efficiency and consequent inevitably short life, and vice versa, makes it practicable to aim at a higher target than before. As a result it has been possible to stiffen B.S. Specification 161 for general service filament lamps to require some 3 per cent. greater efficiency than previously, with the same 1,000 hours average life—a standard which would have excluded all but the very best a few years ago.

Bearing in mind that the cost of a filament lamp is only a small element in the cost of producing light, an increase of 3 per cent. in its efficiency gives the average consumer some 15 per cent. better value for money when he buys his lamp, and also makes it still more attractive to embark on a systematised plan of group replacement which requires above all else a uniform lamp performance.

One of the most important recent developments is the introduction of G.L.S. lamps from 40 watts to 200 watts with an internal coating of silica. These are constantly growing in popularity, the 5 per cent. absorption of light unavoidable in the silica coating of high-voltage lamps being more than offset by the softness of the lighting they give and the lack of shadows cast by the suspension and lip of popular types of domestic fittings.

### Projector Lamps

In 1946 the British Standards Institution set up a committee to deal with the standardisation of projector lamps of all types, and this adopted as a basic feature the pre-focus cap and holder which avoids any need for individual adjustment of the lamp position by the operator. This is of the utmost value, not only in the popular use of projector lamps of standard and substandard types, but also in scientific investigation. Even lighthouse lamps are now available which are designed to take the place of oil lamps but suit the existing optical control.

* Director of the Electric Lamp Manufacturers' Association.

*Fig.* 1. *The filament image of a headlamp bulb is brought into a predetermined position on the screen, then the pre-focus ring is fixed to the cap. This ensures correct location of the filament with respect to the headlamp reflector.*

### Automobile Lamps

The evolution of the British prefocus headlamp, which is now standard on all cars made in Britain and exported throughout the world, represents a major contribution to the problem of making the roads safe at night. Instead of a reflector and adjustable lamp housing as was used in the past, and instead of the American "sealed-beam" system where the lamp and reflector are made in one indivisible unit, we have adopted the middle course. Headlamp bulbs are no longer adjustable, but are fitted with a prefocus ring which automatically locks the filament in the correct position relative to the reflector and effectively guarantees that when a new bulb is inserted the beam spread and direction will remain unchanged. Dipping or dip-and-swivel merely requires switching over to an offset filament which is also permanently located at the right position. With this standardised system one does not have to bear the expense of a new reflector every time the lamp fails, but to ensure satisfactory focusing the permissible limits of error in the position of the filament centre relative to the prefocus ring must be far smaller than could be countenanced with the old type of headlamp, where manufacturing errors could—in theory—be corrected by the motorist making his own adjustments. Nowadays, instead of tolerances of 1.5 mm. the permissible limits are down to 0.2 mm., and in some cases even less, and this requires every lamp to be tested on an optical jig for correct filament position before completion.

### Standard Miners' Lamps

A few years ago bulbs for miners' cap and hand-lamps were produced in over 50 varieties to suit the designs of various makers of this equipment—a rather chaotic state of affairs not conducive to low cost or to having a particular type available on demand. By agreement with the equipment manufacturers and as a result of standardisation the National Coal Board and the Ministry of Fuel now include only the lamps shown in Table 1 under category 1A.

These, which are krypton-filled to give 20 per cent. more light, are made in accordance with B.S. 535 and will cater adequately for all demands. A special point of interest about them is that care is taken to ensure that the thermo-electric effect at the points where the filament is joined to the nickel supports assists rather than hinders the battery voltage when the lamp is used in its normal position; this can increase the light output by as much as 5 per cent.

**Table I**
**Miners' Lamps**

| Code No. | Rating | | Cap | Bulb Diam. mm. | Life Hours | Type | Filling |
|---|---|---|---|---|---|---|---|
| | Volts | Amps | | | | | |
| 11A | 2.5 | 1.75 | 953 | 18 | 250 | Hand | Krypton |
| 12A | 2.5 | 1.75 | E14/23 ×15 | 18 | 250 | Hand | ,, |
| 13A | 3.6 | 1.0 | E10 | 18 | 200 | Cap | ,, |
| 14A | 3.75 | 1.0/1.0 | B15d/17 | 18 | 400 (both fils) | Cap | ,, |
| 15A | 4.0 | 0.8 | E10 | 18 | 200 | Cap | ,, |
| 16A | 4.0 | 1.0 | E14/23 ×15 | 18 | 250 | Hand | ,, |

### Mercury Lamps

The original range of 80-watt to 400-watt hot cathode mercury lamps for general lighting purposes, pioneered by this country, has recently been extended by two new types designed for the efficient and economical lighting of high factory bays. One is rated at 1,000 watts, and is designed for connection through normal control gear between phases of a 3-phase supply of about 400 volts. The other is a single-tube lamp burning horizontally and rated at 2,500 watts.

Though not so spectacular as with other types of lamps, research into these types has also produced solid and satisfactory results in that present-day mercury lamps, chiefly on account of their long lives and better maintenance of light, give over twice as many lumen-hours as their original counterparts. Similar developments have taken place in sodium lamps.

There is a noticeable revival of interest in this country in blended mercury/tungsten schemes, particularly in lofty interiors where there is no difficulty in ensuring a satisfactory mixture of the two kinds of light at working level. A blend giving about equal lumens from each source is usually considered to give an acceptable colour, as is provided by the mercury/tungsten lamps

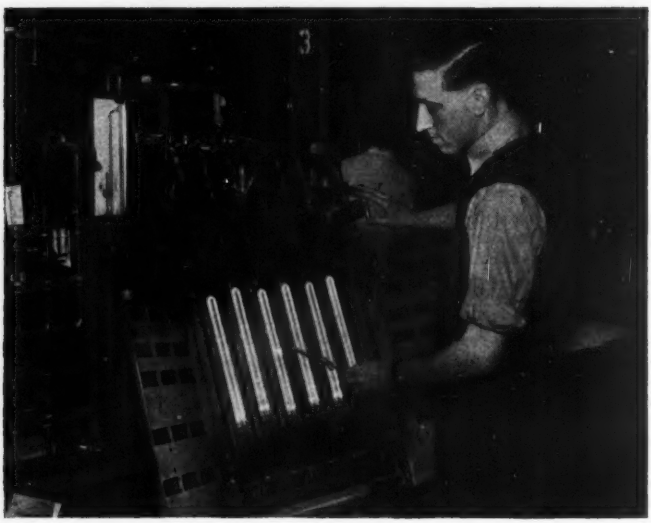
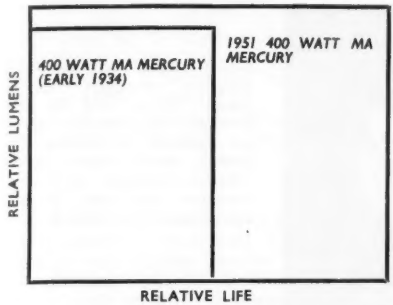


*Fig. 2. Air in these sodium vapour lamp "inners" is exhausted and replaced with a neon-argon gas filling; then freshly distilled sodium of the very highest purity is introduced.*




*Owing to its longer life and better maintenance of light output, the modern mercury lamp, represented by the whole diagram, gives over twice the quantity of light of its* 1934 *counterpart.*

**Table 2**
**Discharge Lamps**

| Rating | Initial Efficiency Lumens/watt | Nominal Average Life (Hours) |
|---|---|---|
| (1) *Mercury Lamps (General type)* | | |
| 80* | 27.0 | 2,500 |
| 125* | 42.0 | 2,500 |
| 250 | 35.0 | 3,000 |
| 400 | 42.0 | 3,000 |
| 1,000 | 48.0 | 3,000 |
| 2,500 | 50–52 | 3,000 |
| * Also in Flourescent bulbs at same efficiencies. | | |
| (2) *Sodium Lamps* | | |
| 45 | 60 | 3,000 |
| 60 | 70 | 3,000 |
| 85 | 76 | 3,000 |
| 140 | 76 | 3,000 |
| (3) *Mercury/Tungsten Lamps* | | |
| 160 | 18.7 | 2,000 |
| 200 | 20.0 | 2,000 |
| 250 | 20.4 | 2,000 |
| 300 | 21.0 | 2,000 |
| 500 | 25.0 | 2,000 |

4) *Mercury (Projector Lamps)*

| Rating | Brightness, cd./in.$^2$ |
|---|---|
| 250 | 130,000 |
| 500 | 130,000 |
| 1,000 | 260,000 |
| 5,000 | 290,000 |

listed in Table 2. These are connected direct to the mains without the need of any auxiliary control gear.

The full range of compact source mercury projector lamps include lamps having a brightness hundreds of times greater than that of a tungsten filament. These special lamps have already proved invaluable to scientists requiring highly concentrated, silent and stable light sources, and their development has involved problems in glass technology such as that of devising suitable seals which will allow heavy currents to be carried through a glass or quartz bulb and in making bulbs strong enough to withstand an internal discharge dissipating up to 50 kw.

### Fluorescent Lamps

Now that the average life of almost all standard types of fluorescent lamp has been raised to 5,000 hours we have reached a stage where any further increase would have advertising rather than practical value and lamp technicians are still, as in the past, much more concerned to increase luminous efficiency than to prolong lamp life which has a relatively small effect on overall lighting costs. But with fluorescent lamps the efficiency, other things being equal, is governed by the colour qualities of the light, and both are independent or nearly so, of lamp life.

We are confident that the two most important qualities in fluorescent lamps nowadays are luminous efficiency and colour rendering, and which of these two a user thinks more important depends on his job and his interests. An industrialist, for instance, probably rates luminous efficiency more important than colour, provided that the latter is at least acceptable, but the restaurant keeper is (or should be) much more concerned with colour than efficiency.

It is an important natural phenomenon, connected with the selective properties of the eye, that a fluorescent lamp which renders colours truly (as in daylight) or as we like to see them (as by filament lamp light) must always be less efficient than a lamp made with equal care and skill but having a preponderance of yellow-green in its spectrum, which distorts colours to a greater or lesser degree depending on how badly the balance of colours in the lamp spectrum is upset.

One of the practical difficulties we are up against is the fact that two lamps which appear to have the same colour may have very different colour-rendering properties. For instance, it would be

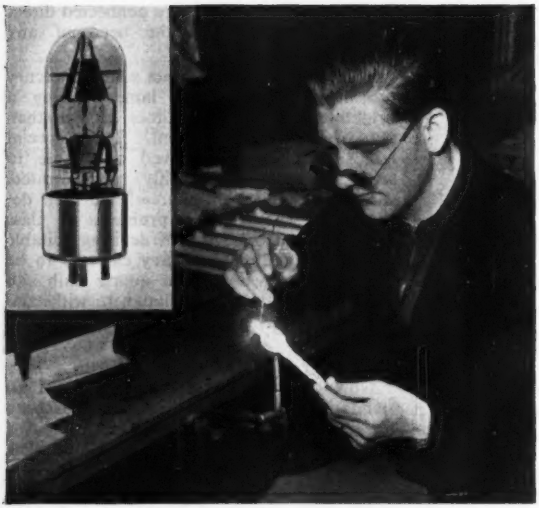
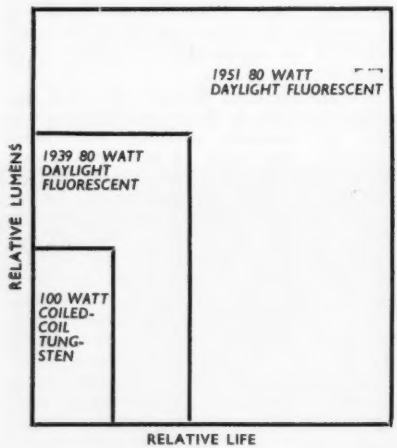
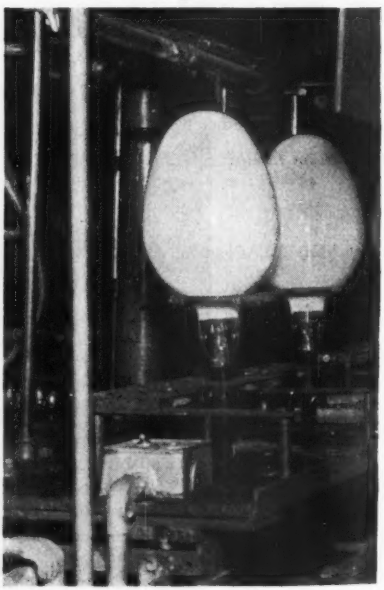


*Fig. 3. Mercury vapour high-pressure compact source lamps (Type ME/D) are virtually hand-made. Here an operator is shaping the quartz bulb, seen more clearly housing the two tungsten electrodes in the completed lamp (inset).*




*The lumen-hours delivered by a modern 80-watt daylight fluorescent lamp are about four times as great as that of a similar 1939 lamp, and nearly 13 times that of a 100-watt coiled-coil filament lamp.*

*Fig. 4. When a degree of colour-rendering is important for functional or psychological reasons the standard 400-watt mercury lamp may be enclosed in an iso-thermal outer bulb internally coated with a carefully blended fluorescent powder. Two of these bulbs are here being exhausted.*



easy to make a high-efficiency fluorescent lamp which has the same colour appearance as a filament lamp, but its colour-rendering would be quite different, and to do so would add to present difficulties. Alternatively, one could make a fluorescent lamp of similar colour having the same or nearly the same colour-rendering as filament lamps, but it would certainly be of relatively low efficiency.

So when it becomes possible to effect some improvement in fluorescent lamp performance, as occurs from time to time through the efforts of research, the question always arises: shall we improve efficiency and keep the colour-rendering as before, or shall we improve the colour-rendering leaving efficiency as before, or a bit of both? The question is by no means an easy one to answer bearing in mind the multitude of different purposes for which the lamps are used in various lands.

At the present time the standard range of fluorescent lamps contains five "white" colours, the colour-rendering properties of which are indicated by quoting their luminance in each of eight spectral bands, as laid down by the International Commission on Illumination (C.I.E.). These are as follows:—

Daylight, Warm white } Lamps of very high efficiency.

Mellow—Lower efficiency but good colour-rendering.

Colour Matching—Equal efficiency to Mellow, but near natural daylight colour-rendering.

Natural—Intermediate characteristics as regards efficiency and colour-rendering.

The introduction of highly efficient halophosphate fluorescent powders has already given lamp manufacturers opportunities, which they have taken, for improving the efficiencies and colour characteristics of fluorescent lamps. Intensive research continued throughout the next few years is likely to bring further improvements in both the above qualities, which will have the effect of widening the field of usefulness of fluorescent lighting generally.

## Personal

Fellowship of the Illuminating Engineering Society has been awarded to MR. HARRY HEWITT. Mr. Hewitt is lighting specialist with the North Western Electricity Board and has made a special study of lighting in the textile industry, on which he presented a paper at the I.E.S. Summer Meeting at Buxton in 1950.

The names of MR. E. C. B. MORGAN, of London, and MR. D. SCULTHORPE, of Manchester, have been added to the I.E.S. Register of Lighting Engineers.

MR. JOHN REID, A.R.I.B.A., M.S.I.A., has been appointed Design Consultant for the "Atlas" Lighting Division of Thorn Electrical Industries, Ltd. Mr. Reid designed the "Forrest Modern" fittings for George Forrest and Son, Ltd. His new activities will extend to industrial and commercial fluorescent lighting equipment.

MR. G. HONNORATY has been appointed senior lamp and lighting salesman at the B.T.H. District Office in Birmingham. Previously he was manager of the company's Nottingham Depot.

*Information and Catalogue from*

**DEUTSCHE VERKEHRSAUSSTELLUNG,**

**Munchen 12, Theresienhöhe 14.**

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**123 Pall Mall, London, S.W.1**

**Tel.: WHitehall 8211**

# British Fluorescent Street Lighting Abroad

By H. E. G. WATTS,*
A.M.I.Mech.E., Assoc.I.E.E.

**Fluorescent street lighting originated in this country, and installations of British equipment are now in use in many countries. The following article discusses some of the advantages of this type of street lighting.**

The British lighting industry has always played quite a considerable part in export, but since the development of fluorescent street lighting using the tubular fluorescent MCF/U type of lamps was developed in 1946 an even greater contribution has been made to the better lighting of streets all over the world.

The total number of installations using British equipment are so numerous that a complete list would look almost like a catalogue, and the few examples shown here are typical, indicating the many varieties of application of this relatively new method of street lighting.

The first practical installations in Great Britain, and in fact, as far as is known, anywhere in the world, were installed in August and September, 1946, the latter during the London Conference of the A.P.L.E. It was immediately recognised by the majority of street lighting engineers that this new application of the fluorescent lamp was a great stride forward in the art of street lighting, since previously there had not been any high-efficiency lamp in general use which could, at the same time as being an economical proposition, give an acceptable colour. It may be argued that sodium and mercury lamps do, to some extent, give a colour that is satisfactory from the motorist's point of view. They are acceptable, however, only when the motorist is seeing mainly under conditions of silhouette vision. In the more built-up parts of cities and towns, towards the centre, a good colour is generally considered to be a great advantage, hence the increasing popularity of fluorescent street lighting.

* Lighting Dept., British Thomson-Houston Co., Ltd.

### Early Development Work

With all new types of lamps the lighting engineers consider every possible application. The fluorescent lamp received close attention for a short time before the war, but serious work could not be undertaken until 1945, when it was immediately recognised that the application of this lamp to street lighting had possibilities, first of all for its colour, and secondly for its high efficiency. Experimental work soon showed that the low brightness of the 5-ft. 80-watt 1½-in. lamp enabled far better seeing conditions to be provided, since this, particularly from the vehicle drivers' point of view, is dependent largely on relative light-source brightness and road brightness; if a sufficient road brightness can be provided with a low brightness light source, then very much greater visibility will result.

### Lantern Design

When the fluorescent lamp was being considered for street lighting, current practice dictated a main beam candle power in the region of 5,000 at an angle to the downward vertical of about 75 deg. The size of the fluorescent lamp immediately indicated that a very large reflector would be necessary to get sufficient candle power from one lamp, and the maximum practical size of reflector would only contribute just under 2,000 candle power per lamp to the main beam. The first experiments were made with lanterns containing as many as seven lamps in

**Table 1**
**Brightness and Size of Light Sources**

| Lamp watts | Description | Initial lumens | Initial Lm/w | Source size, mm. (approx.) | Approx. max brightness. Candles per sq. cm. | Colour and Rendering |
|---|---|---|---|---|---|---|
| 500 | Tungsten filament | 8,660 | 15½ | 40 × 1 | 1,000 | White—good |
| 400 | Mercury, glass | 14,400 | 36 | 160 × 5 | 150 | Greenish — considerable distortion |
| 400 | Mercury glass fluorescent | 12,800 | 32 | 335 × 165 | 50 | Greenish—some distortion |
| 125 | Mercury, quartz | 4,100 | 33 | 178 × 90 | 35 | Greenish — considerable distortion |
| 125 | Mercury, quartz fluorescent | 4,100 | 33 | 233 × 130 | 20 | Greenish—some distortion |
| 140 | Sodium | 9,000 | 64 | 400 × 35 | 7 | Yellow — considerable distortion |
| 80 | Tubular fluorescent, mains voltage | 3,200 | 40 | 1,450 × 38 | 0.7 | Daylight and Warm White —Very Good |

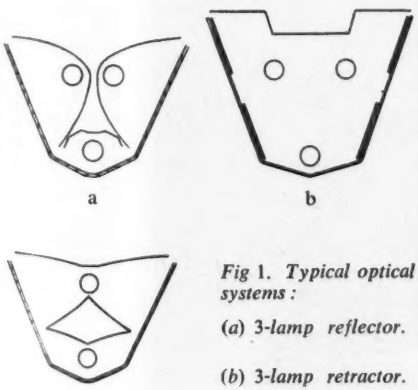



*Fig* 1. *Typical optical systems:*

(*a*) 3-*lamp reflector.*

(*b*) 3-*lamp retractor.*

(*c*) 2-*lamp reflector.*

order to achieve this apparently desirable figure of 5,000, but further work indicated that because of the low source brightness lower candle power would be acceptable, and as a result the typical three-lamp lantern shown in Fig. 1 (a), using three 5-ft. 80-watt lamps, was developed. The two alternative optical systems have various points for and against their use.

Variations of the three-lamp lantern have been used in many installations, and both the two- and four-lamp versions will comply with the current British Standard Code of Practice for group "A" road lighting, although the former is rather close on the lower limit if lumen output only is considered as a criterion. Nevertheless, excellent visibility on the narrower type of street has been obtained, and results are acknowledged to be perfectly satisfactory.

The problem of enclosure was one of the earliest apparent snags, but since the widespread development of plastics this has been solved and the normal type of enclosure

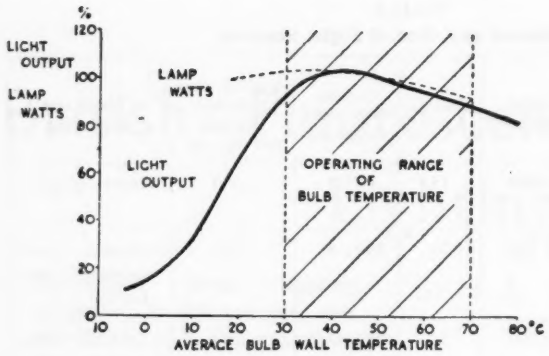



*Fig.* 2. *80-w. fluorescent lamp—variation of light output and power consumption with temperature.*

tends to be a "Perspex" trough which gives adequate protection from weather and dirt.

### Cold Weather Operation

The size of the lantern is such with the fluorescent lamps that there is adequate space for any of the normal types of control gear. Both instant start and starter switch operation are satisfactory in the majority of climates.

Experience has shown in practice that efficient starting and operation are achieved in practically every climate including the extremes of high and low temperature, although perhaps the thermal starter switch circuit gives a more reliable start at extremely low temperatures. Early laboratory tests indicated that satisfactory starting takes place at temperatures down to 20 deg. C. on a 240-volt supply, provided that the voltage variation remains within the normal limits of ±6 per cent. Later practical experience in Sweden and Denmark has proved these results. The light output of lamps decreases to some extent at low temperatures, but as soon as the lamp has been in operation for a short time the interior temperature of the lantern rises and the loss in light output is seldom sufficiently great to be considered serious.

### Maintenance

The two major considerations from the maintenance point of view are cleaning and lamp changing. Experience has shown over six years of fluorescent street lighting that

*Fig.* 3. *Rio de Janeiro—Part of a B.T.H. installation, using over* 600 3-*lamp lanterns with* 5-*ft.* 80-*w. fluorescent lamps.*

*Fig. 4. Bombay—A G.E.C. installation of 3-lamp lanterns using 5-ft. 80-w. lamps, the lanterns mounted in special cradle brackets on steel columns, at a spacing of 120 ft. and mounting height of 25 ft.*

*Fig. 5. Singapore. An installation of Revo Sol-etern lanterns, using two 5-ft. 80-w. lamps, with the lanterns suspended on catenary wires.*

*Fig. 6. Broken Hill, Australia. An interesting application of G.E.C. vertical lanterns, using four 2-ft. 40-w. fluorescent lamps per lantern.*

there is less tendency to accumulate dirt either on the outside of the lantern or inside it. Probably the major reason for both of these is that the lamps, and the lantern itself, run at much lower temperatures than with other types of light source. There is far less chance of dirt being baked on to any surface, and the amount of "breathing" that takes place in a lantern, on switching on and off, is far less because of the lower temperatures, so that less dirt tends to be drawn in. All types of lantern are thoroughly and efficiently gasketed at every joint, but apparatus of this type must of necessity go through a breathing cycle, and there is some tendency for a certain amount of dirt to be inhaled.

Tests on several typical installations have shown that the frequency of cleaning can be halved or further reduced when fluorescent lanterns are substituted for other types, and thus one of the major considerations, the labour cost, is cut down enormously.

The second item in maintenance costs is lamp renewal. This can be divided into two, the first being the cost of the lamps and the second the labour required to effect the changes. Even the earliest installations were operating with lamp lives which suggested changing once a year, all night lighting in Great Britain amounting to approximately 4,000 hours per annum. Since then there have been considerable advances in lamp manufacturing technique, and longer periods between lamp changes are common. When these intervals are considered it is easily seen that, when compared to the necessity for changing tungsten filament as often as every 1,000 hours, considerable savings can be brought about.

### Results in Practice

One of the most difficult problems facing the public lighting engineer is the provision of satisfactory lighting under wet road conditions, where, in the past, the smaller high-brightness sources tended to give a pattern of relatively glaring streaks on the wet carriageway with extremely dark spaces in between. Under these conditions the lighting can be positively dangerous, and there is very little that can be done to get over

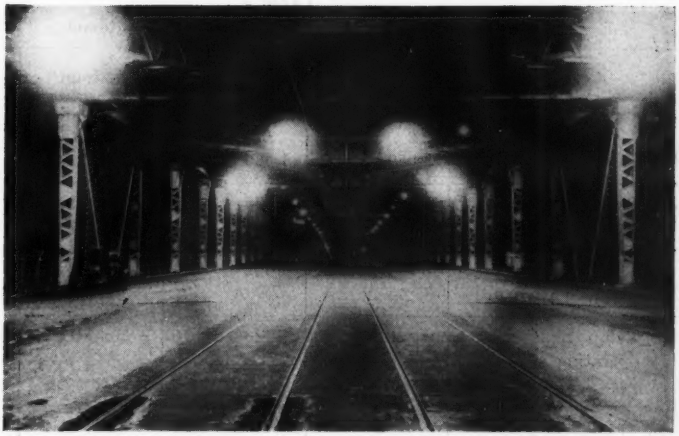


*Fig. 7. The Howrah Bridge, Calcutta, showing the first section of B.T.H. 3-lamp fluorescent lanterns using 5-ft. 80-w. lamps.*

*Fig. 8. Malmo. An interesting example of Revo Sol-etern lanterns at a bus station. (Sol-etern lanterns are available for 2, 3 or 4 fluorescent lamps.)*

**Table 2**
**Cost Comparison for Group "A" Lanterns**

| | Fluorescent 3×80 watts | Mercury 400 watts | Sodium 140 watts | Tungsten 500 watts |
|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| (1) Capital cost per mile | 3,050 0 0 | 1,080 0 0 | 1,125 0 0 | 535 0 0 |
| (2) Capital cost per mile per annum | 381 0 0 | 135 0 0 | 140 0 0 | 67 0 0 |
| (3) Running cost operating 4000 hrs. p.a. | 220 0 0 | 462 0 0 | 176 0 0 | 550 0 0 |
| (4) Lamp replacements operating 4000 hrs. p.a. | 68 0 0 | 163 0 0 | 208 0 0 | 79 0 0 |
| (5) Total cost per mile p.a. | 669 0 0 | 760 0 0 | 524 0 0 | 696 0 0 |
| (6) Lumens per 100 ft. | 6,050 | 6,180 | 5,280 | 4,900 |

NOTE (1) The capital cost given above is for lanterns, and lamp auxiliaries only. Lamps are excluded and are considered as a maintenance item. Columns and erection are also excluded as they are nearly constant for all types of lighting.
(2) The capital cost is amortised over 10 years at 12½ per cent. per annum.
(3) Running cost is for electricity at 1½d. per kw.h.
(4) Lamp replacements allow for operating one fluorescent after midnight.
(5) Spacing 120 ft.
(6) Light output below the horizontal.

*Fig. 9. Singapore. G.E.C. decorative lanterns outside a municipal building, each lantern using four 2-ft. 40-w. fluorescent lamps.*

*Fig. 10. Mombasa. The first part of an installation of 180 B.T.H. 3-lamp 80-w. 5-ft lanterns mounted on overhead line poles.*

this snag. To some extent a similar situation arises on the main thoroughfares in big cities where the road surface tends to become polished, even under dry conditions. The fluorescent lamp offers a great improvement in seeing under these conditions in that its brightness is so very much lower than other types of lamps and that the size of the light source is so much greater, so that the resulting bright streaks on the road are of a much lower order of brightness, and the contrast between them and the dark areas is less. At the same time, the width of the bright streaks is considerably increased, thus effecting greater road coverage both under wet and dry road conditions.

### Economics

It is obvious from the size of the typical lantern used for main road lighting with fluorescent lamps that its cost must be higher than the average type of lantern previously used, and therefore the capital cost of the installation will undoubtedly also be increased, but if an analysis of operating costs is compared to the amortisation of capital over a reasonable period, it will be found in many cases that fluorescent street lighting shows an over-all saving. In certain cases where the cost of electricity is as high as 4d. per unit (or the equivalent in local currency) economic comparisons have shown that there is no doubt about fluorescent street lighting being by far the cheapest in quite a short period, in fact, in certain situations where mercury or sodium are not acceptable the only alternative of tungsten filament lamps has been shown to be uneconomic.

Where all-night lighting at full intensity is required, fluorescent street lighting will show a good comparison with any other type which provides similar visibility, and it should be borne in mind here that the criterion is visibility and not purely quantity of light provided. With most lanterns it is possible to switch down to one lamp from three and thus maintain lighting of a sufficient degree for police purposes and sparse traffic conditions after, say, midnight, at a very much reduced cost.

### Further Developments

Since the original types of two-, three-, and four-lamp lanterns using 5 ft. 80-watt lamps became established there have been many other applications for side street, or group "B" lighting, using in some cases 2 ft. 40-watt lamps, and various versions of decorative lanterns have been developed, largely using the lamps in the vertical or near vertical position. Whilst this type have, perhaps, a limited application there are locations where their daylight appearance at least is more appropriate, and their popularity will, no doubt, increase.

# Floodlighting at Chatsworth

Chatsworth, the Duke of Devonshire's historic and beautiful mansion in Derbyshire, now has a complete floodlighting installation which reveals new and entrancing views of the house and the justly famous gardens.

The floodlighting installation makes effective use of recently developed lamps and equipment, notably the Philips "Altrilux" 500-watt internal reflector lamp, which, without special fittings can be used in the open and even under water. Fourteen of these lamps are actually used below the surface in illuminating the fountains which are such a feature of Chatsworth, and a further 50 are used to give external light to the fountains and arcade, and in the rose garden and some of the avenues. Altogether 282 lamps, 92 of them of high power, are used throughout the gardens, but despite the intensity and variety of the lighting achieved, electricity consumption is only 40½ units an hour.

Sodium lighting is used for the mansion itself, and reveals the architectural beauty and detail of the building. Two floodlights with 140-watt SO/H lamps illuminate the north front and four fittings with similar lamps light the great west front. In the Spray Fountain, which is the centrepiece of the garden below the front, four "Altrilux" lamps are submerged. The south front, with its formal staircase, is lit by five 140-watt sodium floodlights, and in the celebrated Sea Horses Fountain, on the lawn facing this front, four more reflector lamps are used beneath the water.

The magnificent Emperor Fountain, which rises to 60 feet or more, is also seen from the south front, and this great jet is lit from beneath with four submerged lamps,

while four more equally spaced around the basin effectively light the spray and movement of the main jet in the wind.

Sodium lighting (two 140-watt and one 85-watt) is also used to floodlight the elevation of the stables on the north side of the house. Another of the great features is the cascade, which tumbles down the hillside behind the house. Altogether 23 reflector lamps are used here, and four more light the rose beds and the façade of the camellia house in the French gardens.

The fountain tree has delighted visitors for very many years, but the three "Altrilux" lamps which light its many branching jets give a new and altogether lovely view. So, too, do the two lamps lighting the waterfall over the Wellington Rock, and the three narrow-angle lamps lighting the little ravine leading up to the rock.

The tree-lined walks and long vistas of Chatsworth are lit with a combination of frosted wide-angle "Altrilux" lamps, and 1,000-watt Class B1 projector lamps in "Westgate" fittings placed in the trees, while the Florentine temple is revealed by one fitting with 1,000-watt projector lamp hidden from view by a neighbouring wall.

The route from feature to feature has been marked with 200 15-watt pearl lamps mounted low down so that they do not distract from the main spectacles.

The installation has been carried out by the estate electricians, and the floodlighting was designed and equipment supplied in conjunction with Allan Eyre Ltd., of 191 Chatsworth Road, Chesterfield, by Philips Electrical Limited.

*Fig. 2. The Wellington Rock Waterfall, in the grounds of Chatsworth.*

# British Industries Fair, 1953

**The British Industries Fair was held from April 27 to May 8. Lighting exhibits were seen at Earls Court and Birmingham.**

This year the stand of the General Electric Co., Ltd., at the British Industries Fair told the story of lighting. The presentation followed the lines which research, development and application have taken since the early days of electric light.

A colourful pillar fitted with fluorescent tubes attracted attention to a feature which displayed examples of the range of lamps which the G.E.C. manufactures.

The G.E.C. has been engaged in the development of the filament lamp from its infancy, and a section of the stand was devoted to an historical survey which traces the evolution of the lamp from the earliest carbon filament lamp through the simple coiled tungsten filament to the coiled filament lamp.

The story of the discharge lamp was outlined in three ways; by a working model of a Geisler tube operating from a spark coil, a demonstration showing the effect of coating coloured fluorescent powders on the inside of tubes containing suitable gases, and a number of models which showed how the modern discharge lamp is used, for instance, in street lighting.

Good street lighting is essential for public safety of the roads at night, and enlarged colour transparencies of tungsten, sodium, fluorescent and mercury vapour street lighting indicating the suitability of each to a particular situation were shown as well as various street lighting lanterns including the new post-top lantern housing five 8-ft. U-shaped cold cathode tubes.

A special application of exterior lighting was demonstrated in a section devoted to airport lighting. A diorama device gave the viewer a pilot's-eye view of an airport as the plane is brought in to land. Both airport approach lights and general airport lighting were clearly visible and a dimmer system enabled the diorama to be converted from a day to a night scene.

The new products shown by Falk, Stadelmann and Co., Ltd., have been designed to assist the country's export trade by catering for overseas markets. The fluorescent fittings were primarily for industrial use and included the "Colne" fittings, embodying an easily detachable unit which combines an efficient louvre and reflector system with a cut-off at 26 degrees below the horizontal. Others included simple battens and straightforward industrial reflectors in both sheet steel and plastic material.

Also seen were twin blended light units developed for use with a combination of high-pressure mercury vapour lamps and tungsten filament lamps for aircraft hangers and other places where a high intensity of illumination is required with reasonable colour rendering and where high mounting is essential. The two sizes manufactured are for 1,000-watt tungsten with 400-watt H.P.M.V. and 500-watt tungsten with 250-watt H.P.M.V. Other fittings shown included floodlights, street lanterns and commercial lighting fittings.

New products on this year's British Thomson-Houston Co. Ltd.'s stand were given added interest by actual demonstrations of equipment being manufactured and in operation.

On the lighting side, an item of interest

was a feature detailing the process by which filament lamps are made. This traced, by means of flow diagrams and transparencies, the manufacture of tungsten wire for filaments from the tungsten ore through the main stages of milling and purification, to its conversion into metal bars and finally a fine wire which in many lamps is far finer than human hair. A filament coiling machine was also operating on the stand.

The final stage of the feature showed the assembly of the lamp components and some of the regular tests that are made to ensure uniformity of construction and quality.

A new Mazda lamp, the 75 watt reflector spotlight was shown. This lamp is probably the first standard light source of its kind to fit an ordinary domestic lamp holder and has many applications in the home, in industry and in shops and stores. Each lamp has an internal parabolic type reflector and satin frosted crown. The result is a powerful beam of controlled light which is extremely useful for close work.

The new lighting fittings shown included the new "Monolux" 5ft. single lamp fluorescent fitting which is of entirely new design. Among the most important of the features in this fitting are the new fixed lamp holder which permits one hand lamping from either end, the "Pendicone" method of rapid installation and new types of choke and capacitor.

Blended light units were also demonstrated and one of these incorporated an entirely new high-bay tungsten lamp reflector which can also be used as an independent fitting.

Shown for the first time was a new 4-lamp cold-cathode fitting and a number of new street lighting lanterns.

The Stanton Ironworks Co. Ltd.'s exhibits included six spun concrete lighting columns, four of which were manufactured by the prestressed spun process and two by the reinforced spun process. The columns, after spinning, are mechanically ground to a smooth granolithic finish; the density of the concrete will resist corrosive atmosphere without maintenance.

Revo Electric Co. Ltd.'s exhibits took the form of street lighting standards and lighting fittings and comprised columns in concrete, tubular steel and cast iron. The concrete columns shown were examples of the "Angelo" Standard for Group B roads and "Scopas" Standard for Group A roads, both of which were shown in polished and ground finishes. The lighting fittings displayed on the columns included "Silver-blue" mercury vapour discharge lamps and "Silver-gold" sodium vapour discharge lamps and "Sol-etern" for 2-ft. and 3-ft. fluorescent lamps.

Oak-finished standard and table lamps were shown by the Bank Hardware Manufacturing Co., Ltd. Other interior fittings were seen on the stand of the Osborn Manufacturing Co., Ltd., who were showing a completely new range of decorative fittings. Another wide selection of decorative fittings was exhibited by Berry's Electric, Ltd., whose range included hotel, bathroom and domestic lighting units as well as a number of fabric shades and standard lamps. Pendants and wall brackets, table lamps and other electric fittings were shown by Harry J. Pratt and Co., Ltd. Holt, Siron and Co., Ltd., displayed their new "Mirrexo" illuminated mirror.

The Davenset low voltage lighting was shown by Partridge, Wilson and Co., Ltd. This unit is used in workshops and garages for supplying low voltage lighting, and four 36-watt handlamps can be operated off the one transformer. The Electrical Depot, Ltd., also showed low voltage fittings, including industrial local lighting fittings, Lens Lite—an illuminated magnifier power cable supports, etc.

A. C. Morrison showed a small portable 300/450-watt, 6-, 12-, or 18-volt D.C., low voltage, safety generating set for general lighting applications such as caravans, bungalows, yachts and other places away from public supplies of electricity.

William McGeoch and Co., Ltd., exhibited a range of industrial and decorative lighting fittings, including electric fittings for ships—in which this firm specialises—and a range of yacht lighting fittings.

A variation to the conventional type of lighting wiring was shown by Pyrotenax, Ltd., whose exhibit incorporated both cantenary and concentric wiring systems. Auto Diesels, Ltd., exhibited selections from their generating sets. One of these, of special interest, was a new 500-watt lightweight portable petrol engine-driven alternator.

## Trade Literature

BRITISH THOMSON-HOUSTON CO., LTD.—Illustrated leaflet showing coloured lamps and floodlights. Also leaflet describing the Mazda reflector spotlight, illustrating various applications and giving specifications and prices.

D.S. PLUGS LTD.—Leaflet giving details of the D.S. three-pin fused plugs, hinged pins, unswitched sockets, etc.

EDISON SWAN ELECTRIC CO., LTD.—Two new leaflets, one describing the Windsor range of electrical accessories, the other giving details of the Avon series of A.C. switches.

ELREMCO.—List 98, giving full technical details of this company's short period timers, type SPT, for A.C. and D.C. operation. These timers are fully automatic and can be supplied for any input voltage of up to 500 volts A.C. or 220 volts D.C.

GENERAL ELECTRIC CO., LTD.—Brochure giving full illustrated details of photographic and projector lamps for studio lighting, enlarging, photoprinting, flash photography, etc. Also leaflet on coloured lamps for Coronation lighting displays.

LINOLITE LTD.—Information sheet on new adjustable reflector for 18-in., 2 ft., and 4-ft. fluorescent lamps. This unit is especially useful for a drawing board lighting.

SIEMENS ELECTRIC LAMPS AND SUPPLIES LTD.—Catalogue No. 1020 dealing with Sieray fluorescent lighting fittings and equipment together with the current price list.

THORN ELECTRICAL INDUSTRIES LTD.—This firm's latest Coronation lighting leaflet, AL/121A, giving details of Atlas filament floodlights, spotlights and a novel coronation fluorescent lamp giving bands of red, white and blue. Also leaflet on "Atlas" fluorescent lamps.

THE TINTOMETER LTD.—New leaflet L.S.4 on the Lovibond Schofield Tintometer for measuring the colours of light signals.

THE FRANCO-BRITISH ELECTRICAL CO., LTD.—Catalogue of hot and cold cathode lighting fittings and price list.

ECKO-ENSIGN ELECTRIC LTD.—Leaflet on new combined window spotlight and floodlight.

F. W. THORPE & CO., LTD.—Catalogue No. 1043 giving full details and illustrations on industrial lighting equipment including circular reflectors for tungsten or mercury discharge lamps and lighting troughs for fluorescent lamps.

WILLIAM MCGEOCH & CO., LTD.—Catalogue containing illustrations of new decorative fittings together with the current price list.

BERRY'S ELECTRIC LTD.—Booklet illustrating various lighting fittings as well as fabric shades, lamp standards and bathroom units. A current price list is also inserted.

ELECTRICAL DEPOT LTD.—Catalogue giving details of all this firm's standardised products including local lighting fittings, illuminated magnifiers, etc.

## Correspondence

### Glare

To the Editor, LIGHT AND LIGHTING

Dear Sir,—In the report on the French Lighting Code which appeared in your March issue, you expressed surprise at the statement that "linear sources are more liable to cause glare if vertical than if they are mounted horizontally."

I would remind you that in the paper by Petherbridge and Hopkinson on "Discomfort Glare," which appeared in the I.E.S. Transactions, 1950, No. 2, considerable support was given to this viewpoint.—Yours faithfully,

*Middlesex.* MARTIN GAUGHAN.

### Lighting Terms

To the Editor, LIGHT AND LIGHTING

Dear Sir,—These dimwits who want to be illuminated by luffs and lumas—do they know what a knot is? or a hertz? or even a bar? Or do they recognise speed more easily in miles per hour, frequency in cycles per second, and pressure in pounds per square inch?

Do they want new words for miles per gallon or for lumens per watt?—or can they readily understand what these units mean, without further explanation?

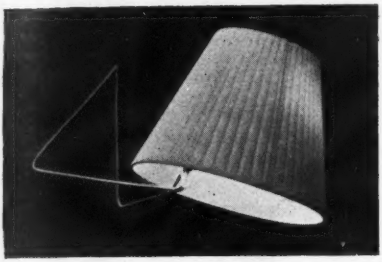
Can they define an apostilb, a lambert or a nit? Even the dimmest wit is surely able to understand a lumen per square foot, and that suits me, too.—Yours, etc.,

*London.* "DEKALUX."

The photograph reproduced on p. 206 shows an installation of Revo "Silverblue" street lighting fittings using mercury vapour discharge lamps at Swann Street Bridge and Haymarket, Melbourne, Australia. It is reproduced by courtesy of the Melbourne City Council Electricity Supply Dept.

# LIGHTING FITTINGS

No. 1.



*"Pin-up" fitting shown here as a wall lamp but which can also be used as a table lamp. Shade is made of a washable plastic tape available in white and pastel shades. Base is of stove-enamelled wire. The fitting will stand up to very hard wear and is easily cleaned.*

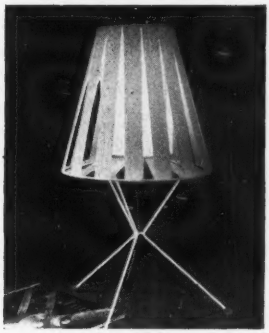
Price, £1 7s. 6d. (P.T. 4s. 5d.).

H. C. HISCOCK, LTD.

*Table lamp with shade based on a Swedish design. An interior cylinder of wrapped plastic diffuses the light from the lamp and the outer plastic ribbons add decorative effect. Shade is 12 in. diameter; material is washable plastic.* →

Price, £2 1s. 0d. (P.T. 6s. 7d.).

H. C. HISCOCK, LTD.



*Cold cathode circular fitting (L.116). Casing of spun metal with bronze finish. Louvres are of interlocking clear mouldings. Lamp is one 16 ft. continuous length of 20 mm. cold cathode tubing (warm white, intermediate or natural).* ← *Frame and louvres can be removed for maintenance without disturbing fitting. Similar but slightly more expensive fitting has glass side panels instead of metal casing.*

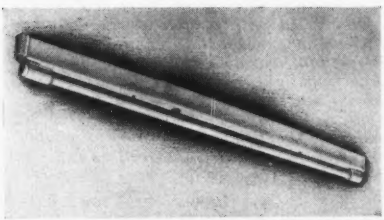
Price, £35 5s. 11d. (P.T. £3 10s. 3d.).

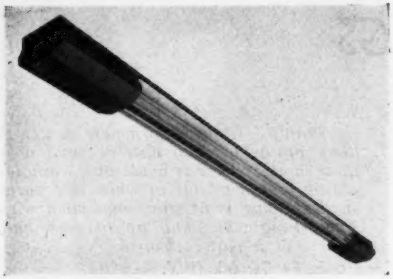
THE FRANCO-BRITISH ELECTRICAL CO., LTD.

*Simple general-purpose fluorescent batten fitting for 5-ft. 80-watt lamps. Constructed in heavy gauge sheet metal, bonderised and finished hot sprayed, stoved white enamel. Gear is held in top part of fitting which is fixed to ceiling. Cover is attached to tray by light chains and is fastened to tray by captive screws after which lamp is inserted.*

Price, £5 10s.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD.





*Four-lamp cold cathode general-purpose fitting for use in industrial and other interiors. The fitting is normally supplied with intermediate white colour lamps, but any colour lamps may be used. It is supplied with or without reflector as required. It is made in one piece so that no assembly work is necessary before erection and is fitted with an interlocking safety device so that power is disconnected when the fitting is opened.*

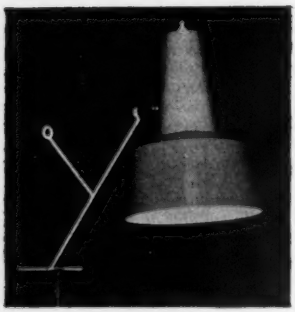
Price, £36.

THE BRITISH THOMSON-HOUSTON CO., LTD.

*Adjustable fluorescent reflector for local lighting of benches, drawing-boards, etc. Adjustable over a wide range of angles with reflector in equilibrium. Reflector is of aluminium with silver-anodised reflecting surface; brackets in tubular steel. Available for single 18-in.-15-watt, 2-ft.-20-watt (as shown, cat. No. SL24) or 4-ft.-40-watt fluorescent lamps. Combined base and gear housing can also be supplied. Exterior surfaces finished in neutral bronze, cream or wrinkle black.*

Price (SL24), £6 7s. 6d.

LINOLITE, LTD.

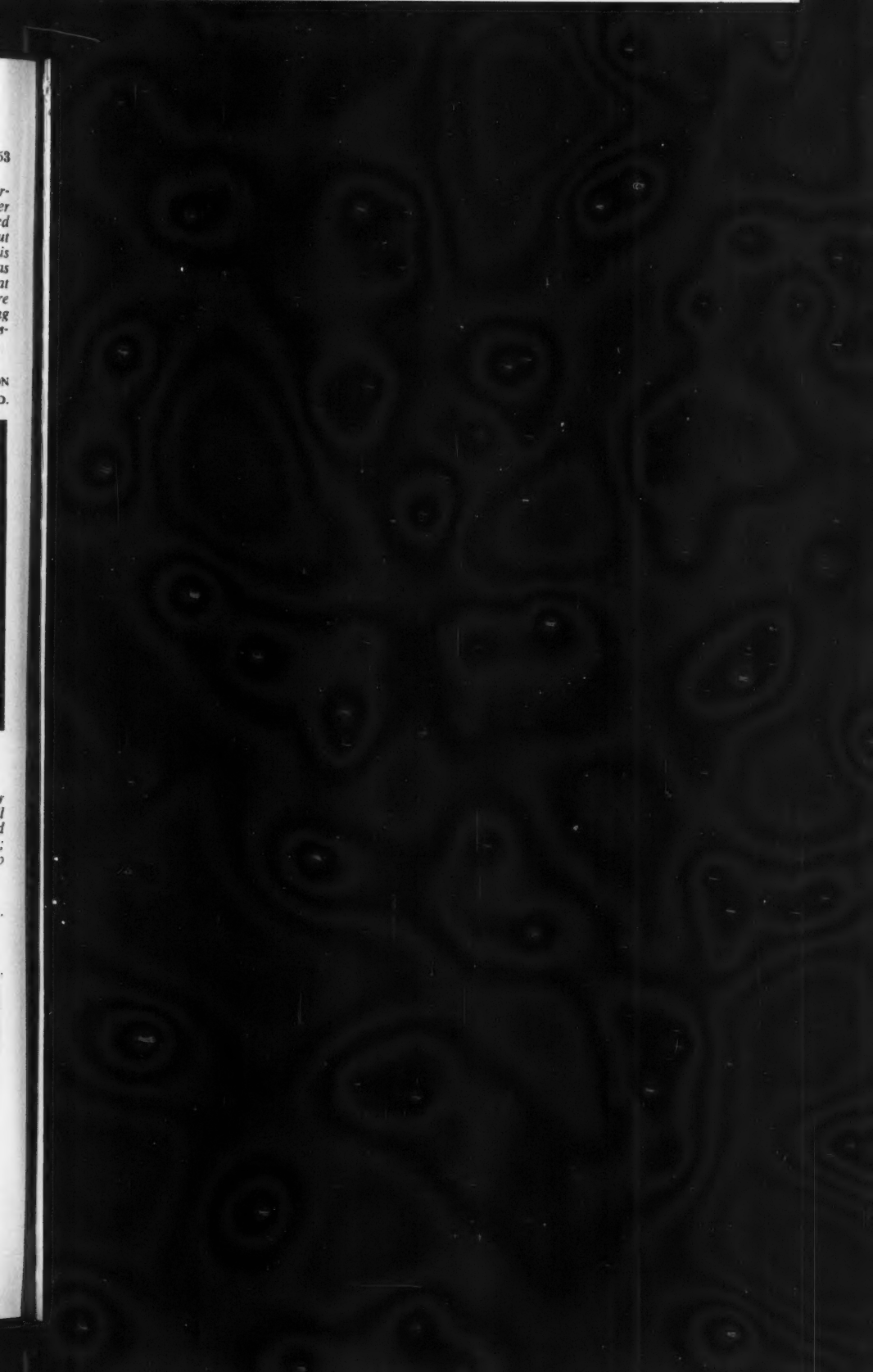


*Wall lamp with 6-in. diameter reflector on universal joint; projection from wall 10 in. to lamp centre. Reflector supplied in red, yellow, black, white or grey; fixtures in black, white or grey; flex to match reflector.*

Price, £3 16s. 6d. (P.T. 12s. 9d.).

BERNARD SCHOTTLANDER.

*Combined window spotlight and floodlight for use with general-service lamps—a clear lamp when fitting is to be used as a spotlight and a pearl lamp for use as a soft floodlight. Fitting can also be supplied with louvred control ring to reduce spill-light and/or with a soffit ring in place of backplate and yoke to enable fitting to be recessed into ceiling.*

Price (as shown), £2 15s.

EKCO-ENSIGN ELECTRIC, LTD.